

Assembly of Intermediate Silicon Tracker in Taiwan

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The INtermediate Tracker (INTT) is the tracker system between the Time Projection Chamber (TPC) and the MAPS-based Vertex Detector (MVTX). INTT makes up the gap between TPC and MVTX, it can precisely reconstruct the track of charge particles. One INTT ladder consists of 59 components, 1 stave, 2-high density interconnects (HDIs), 52 readout chips and 4 silicon sensors. All the components will be fixed by glue and screws. A ladder assembly is performed in the following sequence. 1), Fix the readout chip on HDI by silver epoxy with 26 chips per HDI. 2), Bond the readout chips to HDI using a bonding machine and check the response to slow control commands in a test bench. 3), assemble HDI with readout chips onto stave by thermal glue and screws. 4), Assemble silicon sensors onto the ladder by silver epoxy. 5), Bond the silicon sensors to readout chips by a bonding machine and check the FPHX response again and also silicon sensor performance. 6), Apply an encapsulation to protect the bonding wires. The National Central University (NCU) in Taiwan is responsible for one-third of the INTT ladder production.

The assembly procedures 1) and 2) are planned to be covered by a private company in Taiwan, and the remaining procedures will be conducted in a clean-room facility at the National Taiwan University (NTU). Figure 1 shows the gantry to be used for the assembly in NTU, which consists of a large flat table with a four-dimensional robotic gantry head. The gantry head is equipped with an optical microscope, which allows a calibration error in position to be the order of 10 μm . Thus far, the assembly procedure requires 9 tools, as shown

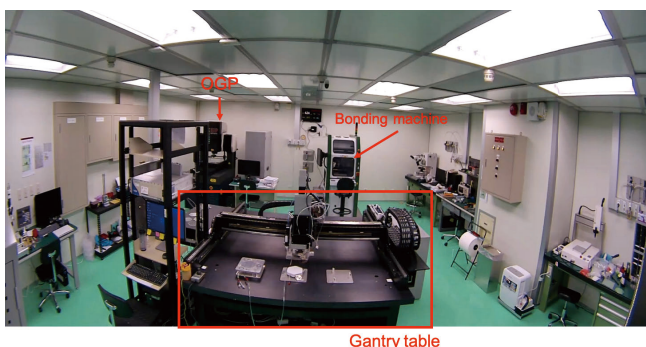


Fig. 1. Photo of the clean room in NTU. Gantry, bonding machine and optical gaging products (OGP) microscope are all available.

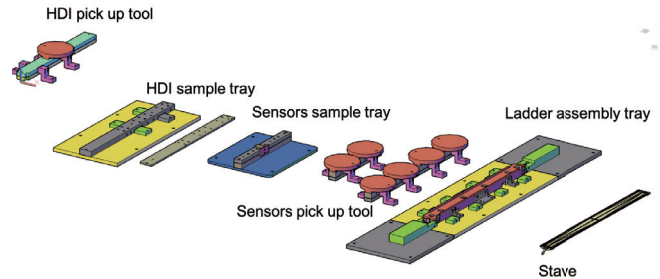


Fig. 2. The designs of the prototype of INTT ladder assembly tools, the assembly tools family.

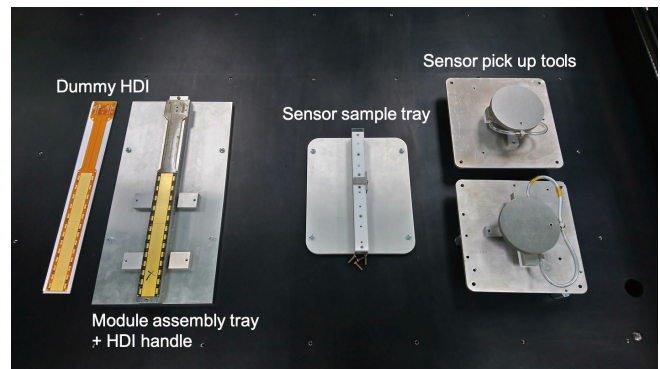


Fig. 3. Assembly tools already fabricated by AS CNC.

in Fig. 2. The assembly unit is one ladder, and the designs of all prototype assembly tools have been completed. The idea is to assemble the entire ladder on the ladder assembly tray, while HDIs and silicon sensors are placed on the HDI sample tray and sensor sample tray by hand, respectively. Pick up tools are used to pick up the HDI and silicon sensors via the vacuum system and move them to the stave by the gantry. An order for the tools has already been submitted to the Academia Sinica (AS) computer numerical control (CNC) factory. The production of 5 has been completed, as shown in Fig. 3. The assembly exercise and bonding exercise are scheduled to start simultaneously in early March. A dummy HDI, dummy silicon sensor, and dummy stave have also been produced, which are sufficient for the exercise. Two important aspects namely, the type of glue and the procedure to apply the glue, are uncertain and need to be determined. Both are expected to be finalized at the end of March. A new INTT test bench has been set up in NCU, and a few checks are to be made to be fully functional.

The conclusion for the INTT assembly in Taiwan is that we aim to provide one functional complete ladder for INTT phase - 3 Test Beam at 22th April.

References

- 1) Conceptual Design Report of sPHENIX (2018).
- 2) The PHENIX Forward Silicon Vertex Detector.

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